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COMPARATIVE PHARMACOGNOSTIC STUDIES ON THE STEM BARK OF *SESBANIA SESBAN* (L.) MERR. AND *SESBANIA GRANDIFLORA* (L.) POIR

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ABSTRACT

A comparative study of the macroscopic and microscopic characters of the stem bark of *Sesbania sesban* (L.) Merr. and *Sesbania grandiflora* (L.) Poir is made. The table shows the differences in the macroscopical and microscopical characters of the two barks and the pharmacognostic characters of the powders in order to identify the two barks easily and properly when they are found in a mixed-up condition.

Sesbania sesban (L.) Merr. (*Sesbania aegyptiaca* Pers.) and *Sesbania grandiflora* (L.) Poir are plants of the family Papilionaceae. In India the stem bark of both plants is used in the indigenous system of medicine for various ailments. The stem bark of *Sesbania sesban* (L.) Merr. is used as astringent, and helps in checking diarrhoea, excessive menstrual flow, reduces enlargements of the spleen and is good in skin diseases. The stem bark of *Sesbania grandiflora* (L.) Poir is also considered astringent, bitter and tonic. It is given as infusion in the first stages of small-pox and other eruptive fevers (Kirtikar & Basu, 1935; Nadkarni, 1954; Gupta, 1908). Pharmacological studies show that the bark is a good source of calcium from the point of view of nutrition (Devadatta & Appanna, 1954). Chemical analyses show that both the barks contain tannin and gum (Nadkarni, 1954; Watt, 1893).

As the pharmacognostic details of these two bark drugs are not available, the macroscopical and microscopical details of the two barks and the pharmacognostic characters of the powders have been worked out with a view to bring out the distinguishing characters by which these two bark drugs can be easily identified in dried or powdered form.

Distribution : Sesbania sesban (L.) Merr. is distributed throughout the tropics of the old world and in India from the Himalayas where it ascends to an altitude of 1220 m in the North West to Ceylon. The plant *Sesbania grandiflora* (L.) Poir is indigenous from Malaya to N. Australia but it is cultivated in Southern or Eastern India in the Ganges valley and in West Bengal (Cooke, 1958; Gamble, 1957; Hooker, 1879; Prain, 1963; Watt, 1893).

Materials & Methods : Stem barks of both the plants were collected from different parts of India, as well as from crude drug dealers. The materials received from the crude drug dealers were compared both macroscopically and microscopically with authentic bark samples in order to ascertain the nature of adulteration, if any. Sections from fresh bark samples were cut in transverse, radial-longitudinal and tangential-longitudinal directions with the help of a hand microtome and these sections were made permanent after suitable staining for measurements, camera lucida drawings or photomicrographs. Sections from fresh stem barks of both the species were cut for standard microchemical tests for the study of the chemical constituents present in these barks. A small quantity of stem bark of each species were dried and powdered and passed through No, 60 B.S.

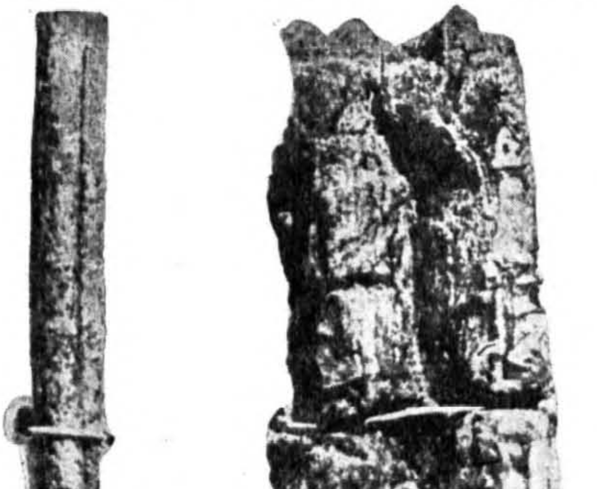

PLATE I

A. Photograph of the stem bark of *Sesbania sesban* × 1

B. Photograph of the stem bark of *Sesbania grandiflora* × 1 sieve and a small portion of each powder was cleared for study of the different diagnostic elements present in these powders.

Sesbania sesban (L.) Merr.

Macroscopic characters: The stem-bark is about 1-4 mm in thickness and becomes double-quilled when dried. The outer surface is greyish yellow, smooth, twisted and with occasional wrinkles. The cork is fused and is difficult to remove from the cortical layer. Internal colour black. Fracture short and brittle.

Microscopic characters: In transverse section the periderm consists of 4-6 layers of phellem or cork cells. The outer portion of the corky layer is replaced by aerenchymatous cells. The cork cells are tangentially elongated, thin-walled and compressed (Plate II, Figs. 1 & 2). The cork cells measure $T = 39\mu - 62\mu - 90\mu$, $R = 12\mu - 18\mu - 23\mu$ and $L = 13\mu - 20\mu - 28\mu$. The phellogen is 2-3 layered, thin-walled broad cells which are very prominent in transverse sections. The secondary cortex which occupies about one third of the total thickness of the bark is composed of thin-walled cortical parenchyma with groups of stone cells which sometimes becomes continuous. Sometimes few stone cells either isolated or in small groups are present near the aerenchymatous layer. The stone cells measure $T = 16\mu - 39\mu - 58\mu$, $R = 14\mu - 23\mu - 35\mu$ and $L = 16\mu - 28\mu - 41\mu$. Small groups of fibres are also present in the secondary cortical region. The fibres measure $600\mu - 3$ mm in length and $12\mu - 23\mu$ in breadth. Prismatic crystals of calcium oxalate are scattered throughout the cortical region. In the inner portion of the seondary cortex large secretory canals either single or in groups are present which contain tannin, protein or a gum like substance (Plate II, Figs. 1 & 2). The cortical cells measure $T = 28\mu - 46\mu - 81\mu$, $R = 16\mu - 23\mu - 29\mu$ and $L = 7\mu - 21\mu - 32\mu$. Secretory ducts measure $T = 37\mu - 46\mu - 69\mu$, $R = 35\mu - 40\mu - 53\mu$ and $L = 32\mu - 41\mu - 58\mu$. The secondary phloem which is upto seventy per cent of the total thickness of the bark consists of sieve tubes, phloem parenchyma, phloem fibres, medullary rays and secretory canals. In transverse section the phloem appears to be narrow conical patches, each of which is separated by wedge-shaped medullary rays. The medullary rays near the cortical region are about 8 – 12 celled wide or sometimes more and becoming one or two cells wide near the periphery of the phloem. The medullary rays near the cortical region are tangentially elongated and contain numerous prismatic crystals of calcium oxalate. Numerous secretory canals either single or in groups are scattered throughout this region. This region is also characterised by the presence of stone cells which are more or less isodiametric. The medullary rays near the periphery of the phloem are elongated radially (Plate II, Figs. 1, 2 & 3). The medullary rays near the cortical region measure $T = 41\mu - 69\mu - 81\mu$, $R = 23\mu - 32\mu - 46\mu$ and $L = 30\mu - 46\mu - 58\mu$ and those near the periphery measure $T = 14\mu - 20\mu - 25\mu$, $R = 30\mu - 39\mu - 48\mu$ and $L = 30\mu - 65\mu - 85\mu$. The phloem parenchyma consists of rectangular cells with sieve tubes and companion cells. Small group of radially arranged phloem fibres are present. Some of the phloem parenchyma contain prismatic crystals of calcium oxalate and starch grains. Secretory canals are present in the phloem region either single or in groups. The

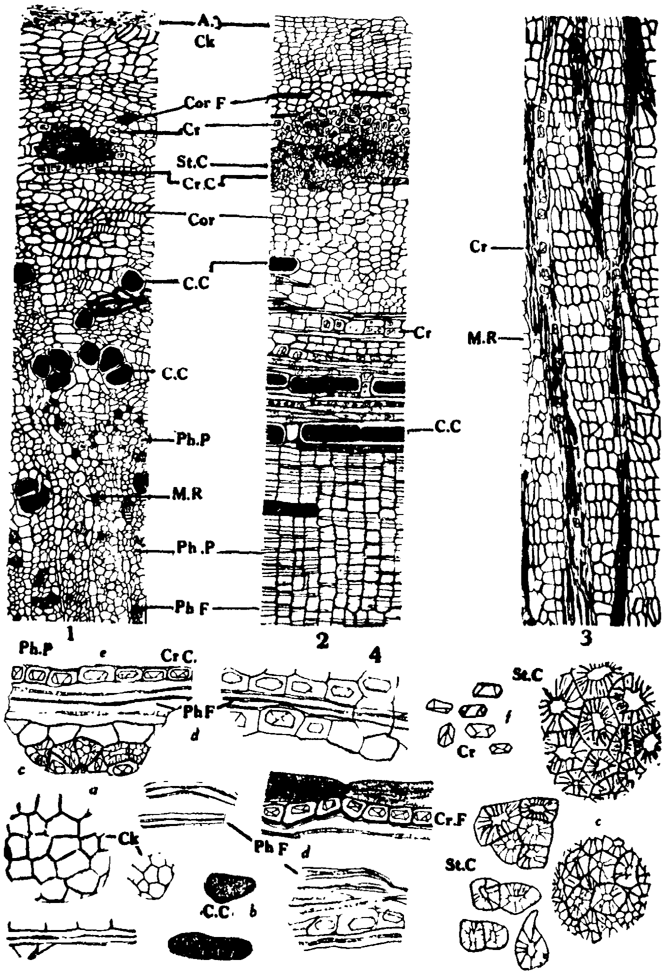

PLATE II : *Sesbania sesban* (L.) Merr.

Figs. 1-4: 1. Photomicrograph of the transverse section of the stem bark of *Sesbania sesban* ×175. 2. Photomicrograph of the radial longitudinal section ×175. 3. Photomicrograph of the tangential longitudinal section ×175. 4. Drawings of the different diagnostic elements as found in the powdered bark ×90.

A = Aerenchyma; C.C = Cell contents; Ck = Cork; Cor = Cortical parenchyma cells; Cor.F = Cortical fibres; Cr = Crystals; Cr.F = Crystal fibres; M.R = Medullary ray cells; Ph.P = Phloem parenchyma cells; Ph.F = Phloem fibres; St.C = Stone cells; S.C = Secretory or tanniferrous cells.

phloem parenchyma cells measure $T = 14\mu - 25\mu - 39\mu$, $R = 12\mu - 23\mu - 35\mu$ and $L = 12\mu - 23\mu - 36\mu$. The phloem fibres are generally compact. Some of the phloem fibres are chambered and contain prismatic crystals of calcium oxalate. The phloem fibres measure $500\mu - 4.5$ mm in length and $12\mu - 23\mu$ in breadth.

Powder: Greyish brown colour. Taste astringent and gummy. The powder when examined under the microscope is characterised by the presence of aerenchyma, thin-walled loosely arranged cork cells, stone cells, cortical parenchyma isolated or in groups. Secretory ducts, phloem fibres either isolated or in groups with phloem parenchyma cells, chambered fibres with prismatic crystals are found (Plate II, Fig. 4).

Sesbania grandiflora (L.) Poir

Macroscopic character: The stem bark is about 3-16 mm in thickness. The outer surface of the bark when dried shows a greyish brown to rusty brown in colour with raised rectangular surfaces. The outer phellogen layer can be easily separated from remaining inner portion which is fibrous in nature. The innermost layer is dark brown to chocolate brown in colour. Fracture hard and fibrous.

Microscopic characters: The outer portion of the phellem or cork is replaced by aerenchyma cells which are radially elongated, thin-walled, more or less polygonal in shape and arranged very loosely (Plate III, Fig. 1). The phellem or cork arises in different positions on the outer part of the cortex in thin layers, 2-3 celled wide and elongated tan-

TABLE I

Comparative macroscopic and microscopic studies as well as studies from powder of the stem bark of *Sesbania sesban* (L.) Merr. and *Sesbania grandiflora* (L.) Poir

	Sesbania sesban	*Sesbania grandiflora*
Macroscopic characters:		
Colour:		
Outer surface	Greyish yellow	Greyish brown to rusty brown
Inner surface	Black	Dark brown to chocolate brown
Fracture	Short and brittle	Hard and fibrous
General characters:	When dried becomes double-quilled. Outer surface smooth, twisted and with occasional wrinkles. Cork is fused	Outer surface when dried shows raised rectangular surfaces. Outer phellogen layer can be easily separated from the inner portion which is fibrous. Cork replaced by arenchyma cells in most places
Thickness:	1-4 mm	3-16 mm
Microscopic characters:		
Cork	4-6 layers, thin-walled and compressed; outer portion of the corky layer is replaced by aerenchyma	2-3 layers arise at different positions on the outer part of the cortex. Outer portion of the phellem is replaced by aerenchyma cells which are polygonal, loosely arranged and radially elongated
Phellogen	2-3 layered, thin-walled, broad cells very prominent	Thin-walled cells associated with cortical fibres
Phelloderm:	Cortical cells thin-walled either filled with starch grains or with prismatic crystals of calcium oxalate. In the inner portion large secretory canals either single or in groups are present which are filled with tannin, protein or gum like substances	Cortical cells polygonal or oval either filled with starch grains or prismatic crystals but some of them are filled with cell-contents like tannin, lignin or mucilage and are radially elongated. Large secretory canals in groups of 3-10 are distributed throughout the cortical region
Stone cells:	Thick-walled either isolated or in small groups in the cortex	Stone cells are almost absent
Cortical fibres:	In small groups which measure 600μ-3 mm in length	In groups which measure 500μ-2 mm in length
Phloem fibres:	In small groups, radially arranged, some fibres exhibit mucilaginous layer while others are chambered and contain prismatic crystals of calcium oxalate Fibres measure 500μ-4.5 mm in length and 12-23 μ in breadth	Distributed throughout the phloem region either as compact mass or sometimes radially elongated. Some are with crystals of calcium oxalate. The fibres are generally with large lumen and measure 500μ-2.5 mm in length and 21μ-41μ in breadth
Secretory or tanniferrous cells:	Present smaller numbers and not in groups	Present in large numbers and often in groups of 3-5
Crystals:	Prismatic crystals of calcium oxalate measuring 11μ-$25\mu \times 14\mu$-42μ in diameter	Same
Powder:		
Colour	Greyish brown	Deep brown to chocolate brown
Odour	Almost nil	Slightly pungent
Taste	Astringent and gummy	Mucilaginous

gentially (Plate III, Figs. 1 & 2). The cork cells measure $T=23\mu-60\mu-81\mu$, $R=16\mu-21\mu-25\mu$ and $L=14\mu-28\mu-46\mu$. The phellogen or secondary cortex which occupies about thirty per cent of the total thickness of the bark consists of thin-walled cortical parenchymatous cells and groups of cortical fibres. The fibres measure $500\mu-2$ mm in length and $12\mu-23\mu$ in breadth. Prismatic crystals of calcium oxalate are present in the cortical parenchymatous cells. The cortical parenchymatous cells are polygonal or oval and many of them contain cell contents. The cells which contain cell-contents are radially elongated. (Plate III, Figs. 1 & 2). The cell contents give positive test for tannin, lignin and mucilage as confirmed by microchemical test. The cortical parenchymatous cells measure $T=23\mu-48\mu-98\mu$, $R=23\mu-46\mu-81\mu$ and $L=37\mu-58\mu-92\mu$. Large secretory canals in groups of 3–10 are distributed throughout the cortical region. The secretory canals are tanniferrous as confirmed by microchemical test. The cells measure $60\mu-130\mu\times85\mu-150\mu$ in T.S. The secondary phloem which occupies about seventy per cent of the total thickness of the bark consists of sieve tubes, companion cells, phloem parenchyma, phloem fibres, medullary ray cells and secretory canals. The phloem parenchyma cells are thin-walled, rectangular, polygonal or oval which are smaller in size in comparison to the cortical cells. (Plate III, Figs. 1 & 2). Throughout the bark mucilage is found to be present as confirmed by microchemical test. The phloem parenchyma cells contain prismatic crystals of calcium oxalate. The phloem parenchyma cells measure $T=18\mu-37\mu-51\mu$, $R=12\mu-28\mu-46\mu$ and $L=16\mu-55\mu-96\mu$. The phloem fibres are distributed throughout the phloem region either as compact mass or sometimes radially elongated. The fibres are generally with large lumen and some of them contain prismatic crystals of calcium oxalate and these are termed crystal fibres. (Plate III, Figs. 1, 2 & 3). The phloem fibres measure $500\mu-2.5$ mm in length and $21\mu-41\mu$ in breadth. The medullary ray cells are arranged either serially or they may be distinctly storied. These cells are more or less radially elongated. Medullary rays passing through the phloem usually become 3-5 celled wide, broadened towards the outer part of the phloem and measure $T=16\mu-23\mu-32\mu$, $R=35\mu-58\mu-83\mu$ and $L=30\mu-69\mu-115\mu$. (Plate III, Figs. 1, 2 & 3). The secretory canals are arranged in groups of 3–5 cells. The canals in this region measure $50\mu-130\mu\times70\mu-138\mu$ in T.S. (Plate III, Figs. 1 & 2).

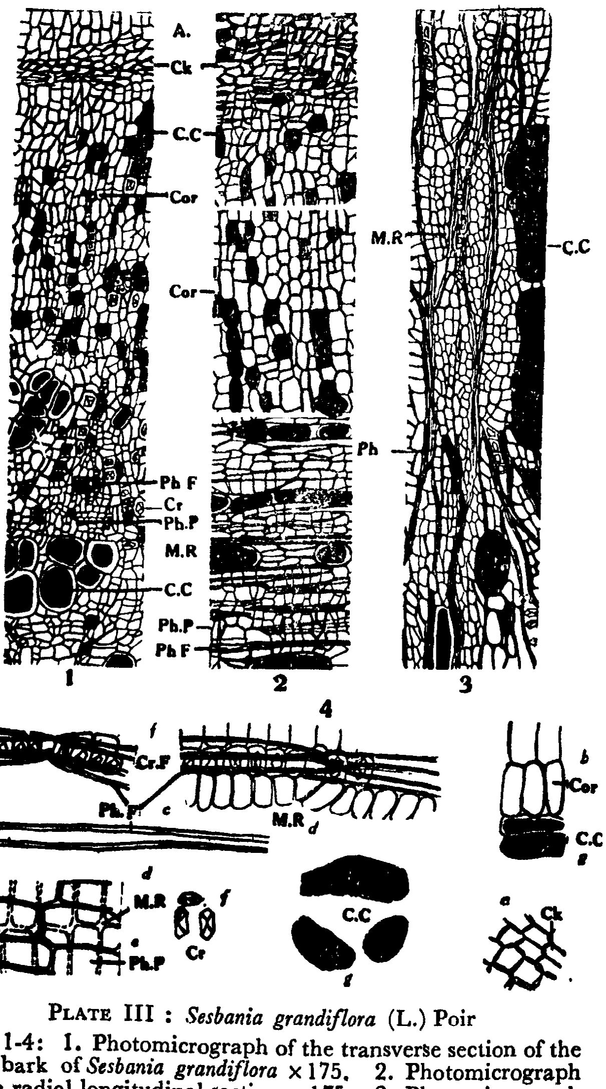

PLATE III : *Sesbania grandiflora* (L.) Poir

Figs. 1-4: 1. Photomicrograph of the transverse section of the stem bark of *Sesbania grandiflora* ×175. 2. Photomicrograph of the radial longitudinal section ×175. 3. Photomicrograph of the tangential longitudinal section ×175. 4. Drawings of the different diagnostic elements as found in the powdered bark ×90.

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Powder: Deep brown to chocolate brown with slightly pungent odour, taste mucilaginous. The powder when examined under the microscope is characterised by the presence of cork cells isolated or in groups, radially elongated cortical parenchymatous cells with or without prismatic crystals of calcium oxalate, phloem parenchyma cells either in small groups or associated with phloem fibres as well as crystal fibres, large secretory canals, medullary ray cells, phloem fibres with or without crystal and numerous prismatic crystals of calcium oxalate. (Plate III, Fig. 4).

Adulteration: The bark samples of both the plants available in Calcutta market were compared with the authentic samples but no adulteration was found.

SUMMARY

A comparative pharmacognostic study of the macroscopic and microscopic characters of the stem bark of *Sesbania sesban* (L.) Merr. and *S. grandiflora* (L.) Poir is made. The results of this study and the diagnostic characters of the powders of these two barks are tabulated in Table No. I. The table gives the distinguishing characters by which these two bark drugs can be easily and properly identified when they are found in a mixed up condition in commercial or powdered samples.

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